D. Remarks

Rejection of Claims 1, 2 and 21-24 Under 35 U.S.C. §102(a) based on Applicant's Background Art (*Background Art*).

The rejection of claims 1 and 2 will first be addressed.

The invention of amended claim 1 is directed to a semiconductor device structure. The semiconductor device structure includes a contact and a gate electrode. The gate electrode includes a nitride film at upper and side portions. Claim 1 further recites an insulating film formed from a gas containing carbon and a silicon nitride film for preventing carbon diffusion. The silicon nitride film for preventing carbon diffusion includes a portion sandwiched between the interlayer insulating film and the silicon substrate and adjacent to the gate electrode in a direction essentially parallel to a substrate surface.

This sandwiched portion has a thickness in a direction perpendicular to the substrate surface that is less than a thickness of the gate electrode in the perpendicular direction. The silicon nitride film also traverses a region except a portion for providing the electrical connection between the contact and the diffusion layer, and is formed on the nitride film at the upper and side portions of the gate electrode.

As is well known, a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single reference.

As emphasized above, Applicant's claim 1 recites a sandwiched portion of a silicon nitride film that is (1) adjacent to the gate electrode in a direction parallel to substrate (2) has a thickness less than a gate electrode in a direction perpendicular to substrate. Such an arrangement is not shown in the rejection's interpretation of the *Background Art*.

The rejection construes a conventional single layer silicon nitride film (item 24 in Applicant's FIG. 16(a)) side wall as two layers:

> [T]he second layer (upper portion of 20 and the outside portion of 24) is the silicon nitride film for preventing carbon diffusion.[1]

However, as is shown in Applicant's FIG. 16(a), the outer portion of film 24 has a thickness well

[1] Office Action, dated 12/12/03, Page 3, Lines 8-9.

beyond that of a gate electrode (16,18).

Thus, Applicant's amended claim 1 includes limitations not shown in the cited reference, and this ground for rejection is traversed.

In addition or alternatively, Applicant reiterates that the *Background Art* clearly shows layers 20 and 24 as single layers and not multiple layers, and nothing in the references or general knowledge available to those skilled in the art supports such an interpretation.

The rejection of claims 21 and 22 will now be addressed.

The invention of amended claim 21 is directed to a semiconductor device structure that includes an insulating film formed from a gas containing carbon. The semiconductor device includes a contact, a capacitor contact that penetrates second and third interlayer insulating films, and a conductor formed on the second interlayer insulating film and below at least a portion of the third interlayer insulating film. The conductor contains a nitride film at upper and side portions. The side portion nitride film is in direct contact with the capacitor contact and the conductor. In addition, the semiconductor device includes a silicon nitride film for preventing carbon diffusion. The silicon nitride film is formed on the third interlayer insulating film while traversing a region except a connection portion between a lower electrode and the capacitor contact. The silicon nitride film is formed above the nitride film at the upper portion of the conductor.

The rejection construes Applicant's single layer interlayer insulating film as having two layers:

> Film 32 is considered a second interlayer insulator (bottom portion) and a third interlayer insulator (top portion) of the same material formed on top of the other.[2]

However, as is shown in Applicant's FIG. 17, the conductor (33 and 34) is not below at least a portion a top portion of film 32, but is entirely above this portion of single layer forming second interlayer insulating film 32.

Thus, Applicant's amended claim 21 includes limitations not shown in the cited reference, and this ground for rejection is traversed.

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[2] Office Action, dated 12/12/03, Page 4, Lines 10-12.

In addition or alternatively, Applicant reiterates that the *Background Art* clearly shows layers 32, 36 and 40 as single layers and not multiple layers, and nothing in the references or general knowledge available to those skilled in the art supports such an interpretation.

The rejection of claims 23 and 24 will now be addressed.

The address this ground for rejection, Applicant incorporates by reference the same general comments set forth above for claim 21. Namely, that the *Background Art* does not show or suggest a conductor formed "on a second interlayer insulating film and below at least a portion of a third interlayer insulating film", as recited in amended claim 23. Further, the rejections interpretation of single layers as multiple layers is in error.

Rejection of Claim 1 Under 35 U.S.C. §102(b) based on *Jost et al.* (U.S. Patent No. 5,900,660).

As noted above, Applicant's amended claim 1 recites an insulating film formed from a gas containing carbon and a silicon nitride film for preventing carbon diffusion. The silicon nitride film for preventing carbon diffusion includes a portion sandwiched between the interlayer insulating film and the silicon substrate and adjacent to the gate electrode in a direction essentially parallel to a substrate surface.

The reference *Jost et al.* does not show or suggest an insulating film formed from a gas containing carbon.

Jost et al. teaches the formation of an oxide-nitride-oxide (ONO) cell dielectric layer. However, such a layer is never shown to be an insulating film formed from a gas containing carbon.[3]

Applicant's resulting claim 1 invention has structural differences over the arrangement set forth in *Jost et al.* Applicant's carbon containing dielectric can provide a higher dielectric constant – as emphasized in the Specification:

> The formation of the Ta_2O_5 film is achieved by a chemical vapor deposition (CVD) method employing pentaethoxy-tantalum $Ta(OC_2H_5)_5$ as stock gas.[4]

[3] See *Jost et al.*, Col. 4, Lines 58-60, which only describes an ONO layer with no other details.
[4] Applicant's Specification, Page 5, Lines 18-19.

> The high dielectric film has a larger dielectric constant than that of silicon nitride. An example of a high dielectric film is tantalum oxide (Ta_2O_5).[5]

Further, Applicant's combination of an "insulating film formed from a gas containing carbon" and a "silicon nitride film for preventing carbon diffusion" can provide advantageous current-voltage characteristics:

> In FIG. 15, the current-voltage characteristics of the transistor formed with the conventional method is illustrated with the broken line... the conventional method diverge from the ideal designed value when the gate voltage is below approximately 0.8 volts.[6]
>
> It is noted that the current-voltage characteristics of the transistor formed with the method of embodiment 1 closely matches the ideal designed value.[7]

Thus, Applicant's invention can provide the structural differences of a higher dielectric constant and greater resistance to carbon diffusion and hence improved current-voltage relationship.

For all of these reasons, claim 1 is believed to include patentable features not shown in or suggested by the cited reference.

Rejection of Claims 21 and 22 Under 35 U.S.C. §102(b) based on *Nakamura et al.* (U.S. Patent No. 5,896,299).

As noted above, amended claim 21 includes a conductor that contains a nitride film at upper and side portions. The side portion nitride film is in direct contact with the capacitor contact and the conductor. Such an arrangement is not shown in the cited reference.

Nakamura et al. shows a second layer wiring 114 (argued to correspond to Applicant's conductor) offset with respect to a third plug 116 (argued to correspond to Applicant's capacitor contact). An unidentified layer 142 (argued to correspond to Applicant's upper and side portion

[5] Applicant's Specification, Page 5, Lines 21-22.
[6] Applicant's Specification, Page 6, Lines 4-10.
[7] Applicant's Specification, Page 28, Lines 2-4.

nitride films) is formed over second layer wiring 114.[8]

However, such a layer is not in direct contact with the third plug, but is in fact isolated from the third plug by interlayer insulating film 115. Accordingly, the limitations of claim 21 are not shown in the cited reference.

For this reason, this ground for rejection is traversed.

Rejection of Claim 2 Under 35 U.S.C. §103(a) based on *Jost et al.* (U.S. Patent No. 5,900,660) in view of *Background Art*.

As is well known, to establish a prima facie case of obviousness, a rejection must meet three basic criteria. First, there must be some suggestion or motivation to modify a reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference(s) must teach or suggest all claim limitations.

Applicant believes that the necessary motivation for the proposed modification is lacking. As is well established, a rejection may not pick and choose selected portions of a reference while ignoring other portions. The entirety of a reference must considered:

> [P]rior art references... must be read as a whole and consideration must be given where the references diverge and teach away from the claimed invention...[9]

The rejection proposes incorporating the tantalum pentoxide of the *Background Art* formed from pentaethoxy-tantalum $Ta(OC_2H_5)$ into the structure of *Jost et al.* However, Applicant's *Background Art* explicitly indicates such an arrangement has a distinct disadvantage: a current-voltage transistor characteristic that diverges from an ideal design at low gate voltages.[10]

It is Applicant's invention of including one or more carbon diffusion prevention layers. Only with the benefit of hindsight obtained by the teaching of Applicant's invention, would one skilled in the art be motivated to pursue the tantalum pentoxide film of the *Background Art*, as the reference teaches away from such an arrangement.

Accordingly, the cited references, when properly considered as a whole, do not provide

[8] See *Nakamura et al.*, FIG. 20.
[9] Azko N.V. v. United States Intl' Trade Comm'n, 1 USPQ 2d 1241, 1246 (Fed. Cir. 1986).
[10] See Applicant's Specification, Page 6, Lines 4-10.

the necessary motivation for the proposed modification.

In addition or alternatively, the teachings of Applicant's *Background Art* would rebut any prima facie case of obviousness.

> [A] prima facie case of obviousness may be rebutted by showing that the art, in any material respect, teaches away from the claimed invention.[11]

As emphasized above, the *Background Art* explicitly teaches away from the disclosed tantalum pentoxide film. Such a teaching is believed to be clearly material as it is the main limitation of claim 2.

For this additional reason, this ground for rejection is traversed.

New Claim 25

New claim 25, which depends from claim 1, recites that the silicon nitride film for preventing carbon diffusion includes a portion having a bottom surface in contact with and extending parallel to the diffusion layer away from the gate electrode and a top surface in contact with an interlayer insulating film.

The limitations of claim 25 are not shown or suggested by the cited reference. In particular, it is noted that *Jost et al.* eliminates any lateral extending portions of the overlying "thin" nitride layer 20.[12]

Claims 1, 21 and 23 have been amended. Claim 25 is a newly added claim.

Claims 1-2 and 21-25 are believed to be in allowable over the cited art. It is respectfully requested that the application be forwarded for allowance and issue.

Respectfully Submitted,

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[11] In re Geisler, 43 USPQ2d 1362, 1366 (Fed. Cir. 1997).

[12] See *Jost et al.*, FIG. 3, in which all lateral extending portions of layer 20 are etched away.

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